

CLAIMS

- [1] A gas-liquid dissolving apparatus that dissolves an oxygen-containing gas into water taken in from an oxygen-deficient water area, increases a dissolved oxygen concentration of the water, and returns the increased dissolved oxygen concentration water to the oxygen-deficient water area, the apparatus comprising:
- an intake unit that takes in to-be-treated water from the oxygen-deficient water area;
 - a supplying unit that supplies the oxygen-containing gas;
 - 10 a bottomed gas-liquid dissolving chamber that has at least one hole formed in a lower portion and that has a top plate provided in an upper portion;
 - a nozzle that ejects the gas supplied by the supplying unit and the water supplied by the intake unit upward so that the gas and the water strike against an inner wall of the top plate, that fills the gas-liquid dissolving chamber with bubbles of the gas and the water, and that vigorously agitates the bubbles and the water by forces of the ejected gas and water;
 - 15 a gas-liquid separating chamber that is provided outside the gas-liquid dissolving chamber while communicating with the gas-liquid dissolving chamber through the holes, that separates the bubbles and the water flowing out from the gas-liquid dissolving chamber through the holes from each other while storing the bubbles and the water, that has a gas-vent hole formed in an upper portion of the gas-liquid separating chamber for releasing the separated bubbles to an outside, and that has a takeout port provided in a lower portion thereof for taking out the water separated from the bubbles; and
 - 25 a water supplying unit that returns the water taken out from the

takeout port to the oxygen-deficient water area.

[2] The gas-liquid dissolving apparatus according to claim 1, wherein the top plate has a dome shape.

[3] The gas-liquid dissolving apparatus according to claim 1 or 2, wherein
5 a tip end of the nozzle is tapered toward an ejection port.

[4] The gas-liquid dissolving apparatus according to claim 1, 2, or 3, wherein the gas-liquid dissolving chamber is accommodated in the gas-liquid separating chamber.

[5] The gas-liquid dissolving apparatus according to any one of claims 1
10 to 4, wherein a total sectional area of the hole is set larger than an area of the ejection port of the nozzle.

[6] The gas-liquid dissolving apparatus according to any one of claims 1 to 5, wherein at least the intake unit, the gas-liquid dissolving chamber, the nozzle, and the gas-liquid separating chamber are installed in the
15 oxygen-deficient water area.

[7] The gas-liquid dissolving apparatus according to claim 1, 2, or 3, wherein

a side surface of the gas-liquid dissolving chamber is formed to be cylindrical or axially symmetric, and the gas-liquid dissolving chamber is
20 accommodated in the gas-liquid separating chamber,

a partition member that has an open upper portion and a side surface of a cylindrical or axially symmetric shape, and that is formed to be tapered toward the upper portion is provided between the gas-liquid dissolving chamber and the gas-liquid separating chamber,

25 the bubbles and the water moving from the gas-liquid dissolving

chamber toward the partition member through the hole are caused to flow out at a predetermined angle with respect to a radial direction of the gas-liquid dissolving chamber, and

5 a circulating stream that moves upward is generated between an outside of the gas-liquid dissolving chamber and an inside of the partition member.

[8] The gas-liquid dissolving apparatus according to claim 7, wherein a formation direction of the hole is set to a direction at the predetermined angle by a thickness of the gas-liquid dissolving chamber.

10 [9] A gas-liquid dissolving apparatus comprising:

a supplying unit that supplies a gas-liquid multi-phase fluid in which a liquid and a gas are mixed up;

a gas-liquid dissolving chamber that receives a flow of the gas-liquid multi-phase fluid in an upper portion and that has a relief hole formed in a lower
15 portion for releasing fluid;

a nozzle that penetrates the gas-liquid dissolving chamber and that ejects the gas-liquid multi-phase fluid supplied by the supplying unit upward toward the upper portion of the gas-liquid dissolving chamber;

a gas-liquid separating chamber that is provided outside the gas-liquid
20 dissolving chamber while communicating with the gas-liquid dissolving chamber through the relief hole, that stores the gas-liquid multi-phase fluid from the relief hole, and that separates the liquid from the gas; and

a takeout port from which the liquid separated in the gas-liquid separating chamber is taken out, wherein

25 a dissolved gas component concentration of the liquid is increased by

agitation caused by a force of ejection from the nozzle and a reflux from the upper portion of the gas-liquid dissolving chamber.

[10] The gas-liquid dissolving apparatus according to claim 9, wherein the upper portion of the gas-liquid dissolving chamber has a dome shape.

5 [11] The gas-liquid dissolving apparatus according to claim 9 or 10, wherein a tip end of the nozzle is tapered toward an ejection port.

[12] The gas-liquid dissolving apparatus according to claim 9, 10, or 11, wherein the gas-liquid dissolving chamber is accommodated in the gas-liquid separating chamber.

10 [13] The gas-liquid dissolving apparatus according to any one of claims 9 to 12, wherein a total sectional area of the relief hole is set larger than an area of the ejection port of the nozzle.

[14] The gas-liquid dissolving apparatus according to claim 9, 10, or 11, wherein

15 a side surface of the gas-liquid dissolving chamber is formed to be cylindrical or axially symmetric, and the gas-liquid dissolving chamber is accommodated in the gas-liquid separating chamber,

a partition member that has an open upper portion and a side surface of a cylindrical or axially symmetric shape, and that is formed to be tapered
20 toward the upper portion is provided between the gas-liquid dissolving chamber and the gas-liquid separating chamber,

the gas-liquid multi-phase fluid moving from the gas-liquid dissolving chamber toward the partition member through the relief hole is caused to flow out at a predetermined angle with respect to a radial direction of the gas-liquid
25 dissolving chamber, and

a circulating stream that moves upward is generated between an outside of the gas-liquid dissolving chamber and an inside of the partition member.

[15] The gas-liquid dissolving apparatus according to claim 14, wherein a
5 formation direction of the hole is set to a direction at a predetermined angle with respect to a radial direction of the gas-liquid dissolving chamber by a thickness of the gas-liquid dissolving chamber.